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Workplan for the formulation of regulations for the exploitation of polymetallic nodules in the Area

Report of the Secretary-General

I. Introduction

1. At its meeting in July 2011, the Council requested the secretariat to prepare a strategic workplan for the formulation of the regulations for mining deep-sea minerals (polymetallic nodules) in the Area. In response to that request, the present report contains a review of the status of the existing regulatory regime and the issues involved in the elaboration of an exploitation code, and an outline of a workplan to produce such a code by 2014.

II. Status of the existing regulatory regime

2. The mandate of the Authority, established between the entry into force of the Convention on the Law of the Sea and the approval of the first workplan for exploitation in the Area, derives primarily from the provisions of section 1 of the annex to the 1994 Agreement relating to the implementation of Part XI of the Convention. This provides, inter alia, that the Authority shall concentrate (a) on the adoption of rules, regulations and procedures necessary for the conduct of activities in the Area as they progress and that, notwithstanding the provisions of annex III, article 17, paragraph 2 (b) and (c), of the Convention, such rules, regulations and procedures shall take into account the terms of the Agreement, the prolonged delay in commercial deep seabed mining and the likely pace of activities in the Area; and (b) on the timely elaboration of rules, regulations and procedures for exploitation, including those relating to the protection and preservation of the marine environment.

3. In accordance with that mandate, the Authority has so far elaborated two sets of regulations governing prospecting and exploration for polymetallic nodules (adopted in 2000) and polymetallic sulphides (adopted in 2010). Work is well advanced on regulations governing prospecting and exploration for cobalt-rich

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ferromanganese crusts and it is anticipated that those regulations will be adopted in 2012. The adoption of the regulations will effectively complete the Authority's regulatory code for deep seabed minerals with respect to the prospecting and exploration phases.

4. At its 2012 session, the delegation of Fiji made a statement (ISBA/17/C/22) supported by other delegations, requesting the Council to take up the formulation of the regulations governing the exploitation of deep sea minerals in the Area. In presenting that request, it was noted that the Authority had, by 2011, approved 12 contracts for exploration in the Area, many of which would terminate in 2016, by which time it was anticipated that contractors would be ready to move to the exploitation phase. They would not be able to do that, however, unless clearly defined parameters for exploitation were in place that would permit contractors to assess the financial risks of proceeding to commercial exploitation. Following that request, the Council requested the secretariat to prepare a strategic workplan for the development of exploitation regulations for consideration at its eighteenth session.

III. Issues to be considered

5. Exploitation is defined in the current regulations as "the recovery for commercial purposes of polymetallic nodules (or sulphides) in the Area and the extraction of minerals therefrom, including the construction and operation of mining, processing and transportation systems, for the production and marketing of minerals". Whether mineral exploitation takes place onshore or in deep seabed areas, there are basic similarities. Regardless of location, the basic activities of any mineral exploitation framework are (a) prospecting; (b) exploration; (c) evaluation; (d) development; (e) mining; and (f) mine closure. Among the most important elements of such a framework would be measures for the protection of the marine environment from the harmful effects of mining, and financial terms, including the payment system selected for the Authority. The payment system takes into account the commercial viability of the operation and its discounted rate of return; it determines what has to be accounted for during specified financial periods; the way costs incurred during the life of the project will be distributed over time; and whether such costs are to be expensed or capitalized, including expenses to be deducted from revenues prior to payments of royalties. It establishes the framework to be administered by the Authority to ensure that it receives the agreed upon payments as well as compliance with its rules, regulations and procedures for exploitation.

6. A regulatory regime can only be developed within an applicable policy framework. In this regard, the 1982 Convention set out detailed and prescriptive policies for the conduct of commercial mining, including provisions relating to production authorizations and the financial terms of contracts. As a result of the 1994 Agreement, however, those provisions of the Convention no longer apply. Instead, the Agreement sets out the principles intended to guide the Authority in the development of rules and regulations for commercial mining. These are contained in sections 6, 7 and 8 of the annex to the Agreement. Together, they provide broad guidance on the policy framework within which detailed regulations are to be developed. Section 6, on production policy, emphasizes that the development of the resources of the Area shall take place in accordance with "sound commercial principles" and that there shall be no subsidization of activities in the Area except as

may be permitted under the provisions of the General Agreement on Tariffs and Trade, its relevant codes and successor or superseding agreements, nor shall there be any discrimination between minerals derived from the Area and from other sources. Section 8, paragraph 1, on financial terms of contracts, provides, inter alia, that:

(a) The system of payments to the Authority shall be fair to both the contractor and to the Authority and shall provide adequate means of determining compliance by the contractor within such system;

(b) The rates of payment under the system shall be within the range prevailing in respect of land-based mining of the same or similar minerals in order to avoid giving deep seabed miners an artificial competitive advantage or imposing on them a competitive disadvantage;

(c) The system should not be complicated and should not impose major administrative costs on the Authority or on a contractor. Consideration should be given to the adoption of a royalty system or a combination of a royalty and profit-sharing system. If alternative systems are decided upon, the contractor has the right to choose the system applicable to its contract. Any subsequent change in choice between alternative systems, however, shall be made by agreement between the Authority and the contractor.

7. While these broad policy guidelines will help to inform and provide a basis for the work of the Legal and Technical Commission and the Council, they will clearly require substantial further elaboration and technical input to discern what they mean in practice. It will be necessary, for example, to understand the prevailing rates of payment for comparable land-based mining and to undertake an economic assessment of the advantages and disadvantages of alternative fiscal regimes to potential seabed miners. Further elaboration of the payment system may be provided through studies on, inter alia, the use of royalty or profit-sharing systems in (a) countries where copper and nickel mine production only started in the past decade; (b) countries where copper and nickel mine production is expected to start this decade and/or where exploration is growing; and (c) countries that have had limited copper and nickel mine production but are expected to become substantial copper and nickel mine suppliers by the end of the decade.

IV. Commercial polymetallic nodule mining

8. One of the most pressing problems with the exploitation code for polymetallic nodule exploitation is the risk associated with the mining and processing systems. Although the testing of collecting systems and equipment, processing facilities and transportation systems is considered a permissible activity during the exploitation phase, to date no exploration contractor has informed the Authority of a decision to proceed with this phase of activities. It is anticipated that such testing, which will be based on one-fifth to half-scale commercial equipment, will call for significant investments, on which some light must be shed regarding the payment system under the exploitation code. Moreover, the amount of time required to construct such systems is not insignificant. So far, none of the exploration contractors for polymetallic nodules have indicated when they propose to undertake the tests. While no formal decision has been announced by any of the contractors on a product mix, an annual production rate, duration of mining operations or a prototype mining system, six contractors participated in a workshop convened by the Authority in

2010 and assisted it in developing the most recent cost model of a polymetallic nodule mining venture in the Clarion-Clipperton Zone.

9. The two areas of major technological uncertainty in a polymetallic nodule mining operation in the Area are the mining system and the processing system. The functioning of the metallurgical plant is totally dependent on the success and viability of the mining stage of the venture and on the existence of raw material, that is, nodules are required to be available on a continuous basis and in specified quantities. Efforts have been made to design metallurgical plants that can also process nickel laterite ores. Similar to a plant that only accepts nodules, such a plant would also have to be tested.

10. During the 1970s, three collecting systems to recover nodules from the seabed were proposed and two were tested. The three systems were the hydraulic mining system, the continuous line bucket system and the modular mining system. Four international consortiums, Ocean Mining Associates (OMA), Ocean Management Incorporated (OMI), Ocean Minerals Company (OMCO) and the Kennecott Group, worked on the hydraulic system and the Continuous Line Bucket Group (CLB Group) worked on the continuous line bucket system.[1]

11. In 1972, the CLB Group financed a test in the Clarion-Clipperton Zone at water depths of 4,900 metres. The tests were conducted over 10 days and a total of 8 tons of nodules were collected. The experiment consisted of one mining vessel that had to be long enough to separate the descending ropes from the rising ones, with the ship moving sideward. Problems of rope entanglement occurred three times during the test. The hydraulic mining system was tested by the international consortiums OMA, OMCO and OMI in the late 1970s. In the OMA tests, a mining ship *R/V Deepsea Miner II* was converted from a 20,000 ton deadweight ore carrier. The testing programme consisted of three shallow water tests at 1,000 metres, one trial at 4,000 metres and four deep water tests at 5,000 metres, which were conducted in the Clarion-Clipperton Zone. In all four deep water tests, operations had to be interrupted because of technical problems or bad weather conditions since the ship was not designed to operate during hurricanes. Continuous successful nodule pumping over 22 hours occurred only during the last test, when 500 tons of nodules were dredged.

12. In 1978 and 1979, a hydraulic air-lift mining system with a self-propelled collector and about one-tenth commercial scale was tested by OMCO at water depths of 5,000 metres also in the Clarion-Clipperton Zone. Tests were considered successful in that they provided large amounts of essential engineering and operational data.

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[1] Ocean Management Incorporated comprised INCO Ltd. of Canada, AMR (Arbeitsgemeinschaft Meerestechnisch geweinnbare Rohstoffe) owned by Metallgesellschaft AG, Preussag AG and Salzgitter AG respectively, SEDCO, Inc. of the United States of America and Deep Ocean Mining Company Ltd. (DOMCO) of Japan; Ocean Mining Associates comprised Essex Steel Company owned by United States Steel Corporation, Union Seas, Inc. owned by Union Minière S.A. of Belgium, Sun Ocean Ventures owned by Sun Company, Inc. of the United States, and Samin Ocean, Inc. owned by Ente Nazionale Idrocarburi of Italy; Ocean Minerals Company comprised Amoco Minerals Company owned by Standard Oil of Indiana, Lockheed Systems Company Ltd. owned by Lockheed Missiles and Space Company Inc. of the United States and Ocean Minerals Inc. owned by Billiton B. V. of the Netherlands.

13. OMI conducted its tests using a converted drill ship, the *SEDCO 445*. The system tested involved a towed collector head with either a hydraulic lift or an air pumping system. Dredging operations were considered successful and approximately 800 tons of nodules were mined.

14. All of the above-mentioned tests have proved that the proposed mining systems of the 1970s can work. At a workshop convened by the Authority in 2008, successful parts of the proposed technologies were discussed. It is unclear whether the development work has been conducted that was required to correct the problems revealed by the tests and to improve upon the concepts so that the final system can be designed. It is also unclear if alternate systems are being designed. Until additional tests are conducted, the reliability and efficiency of the mining and processing systems remain unknown.

V. Cost models of a polymetallic nodule mining venture in the Clarion-Clipperton Zone

15. A preliminary cost model for a deep seabed polymetallic nodule mining and processing venture, with a 20-year life and producing 1.5 million tons per year, was developed at the Authority's eleventh workshop on polymetallic nodule mining technology and the current status and challenges ahead, held in cooperation with the Ministry of Earth Sciences of the Government of India at its National Institute of Ocean Technology in Chennai, India, from 18 to 22 February 2008.

16. Inputs to the model came from 16 technical and legal presentations made by some of the 48 participants at the workshop, including representatives of six of the eight exploration contractors for polymetallic nodule development in the Area at the time. In their papers, the participants, inter alia, described the status of their efforts to develop a cost-effective technology configuration to facilitate the exploration for and mining of polymetallic nodules and their processing into copper, nickel, cobalt and manganese. Contractors were also requested to provide estimates of capital and operating costs based on their selected configurations and production scales and to identify those areas of activity where collaboration could enhance the viability of their ventures. There were also nine other presenters, whose papers focused on an analysis of mining technologies developed in the 1970s and 1980s and model mining units envisaged in the 1970s and 1980s; project economics and cost models that had been developed in the past for deep seabed mining; the economic and technical considerations underpinning the pioneer regime and the Authority's regulations; possible use of space applications for deep seabed mining; the status of lift systems for polymetallic nodule mining; advances in nickel laterite processing and possible applications to polymetallic nodule processing; technology development for polymetallic sulphides and possible applications to nodule mining; and advances in riser technology for oil and gas and possible applications to nodule mining.

17. Presentations were made on, inter alia, technologies that had been tested at water depths of 5,200 metres in the Clarion-Clipperton Zone and had successfully mined 800 tons of polymetallic nodules; the availability of riser technology, subsea power systems and pumps of the magnitude required for polymetallic nodule mining that are currently available on the market; a pilot processing plant with a capacity of 500 kg per day that over a five-year period was used to test various

hydrometallurgical processing routes; and supply and demand for nickel, cobalt, copper, manganese, silicomanganese and ferromanganese. The majority of the inputs, however, were developed in three working groups that were established at the workshop to deal with mining technology, processing technology and the current economics of a polymetallic nodule mining venture to establish a new cost model, as appropriate, or to update an earlier cost model for such a venture, including the scenarios of a non-integrated venture comprising a nodule-mining venture in its own right and a nodule/laterite-processing venture to receive nodules from a deep seabed nodule miner.

18. The first working group provided information on capital expenditure and operating expenditure for polymetallic nodule mining ventures that would recover 1.5 million and 1.2 million wet tons of nodules a year from a site approximately 6,000 nautical miles from a land-based processing facility.[2] The group estimated that capital expenditure for a passive collector system (mining ship and mining system) would be approximately $552 million, for a tracked collector system approximately $562 million, for a system designed around the Chinese collector system approximately $372.6 million and for a system utilizing the Indian flexible riser approximately $416 million. With regard to operating expenditure, the group estimated $94.5 million for the passive hydraulic collector system, $95.7 million for the tracked collector system, $69.5 million for the Chinese collector system and $89.9 million for the Indian flexible riser system.

19. The costs for the transportation system were estimated at $76.7 million per year for three vessels leased each year or $495 million if purchased. The estimate provided by the Government of India was $600 million if the vessels were purchased. The annual operating expenditure for the transportation system was estimated as $93.2 million by the working group, compared with $132.7 million by the Government of India.

20. The second working group provided capital expenditure and operating expenditure information for a probable polymetallic nodule processing plant with an annual capacity of 1.5 million tons, producing nickel, copper, cobalt and manganese. To facilitate comparison with nickel laterite processing plants, both capital expenditure and operating expenditure were reported on a nickel equivalent basis.[3] The working group estimated the capital cost per kg of nickel equivalent at $10 to $14. For a 1.5 million-ton capacity polymetallic nodule processing plant, the group estimated capital cost at $750 million (capital expenditure) and the cost of processing at 3.9 dollars per kg of nickel equivalent, resulting in operating expenditure of $250 million.

21. The third working group reviewed models of first-generation polymetallic nodule mining systems presented by Texas A & M University, the United States Bureau of Mines, the Australian Bureau of Mines and the Massachusetts Institute of Technology and selected the 1984 Massachusetts Institute of Technology report

[2] An operational expenditure is an ongoing cost for running a product, business or system. Its counterpart, a capital expenditure, is the cost of developing or providing non-consumable parts for the product or system.

[3] To obtain the nickel equivalent of the nodule ore, the recovered tonnages of nickel, cobalt, copper (for a three-metal recovery process) and manganese (for a four-metal recovery process) are multiplied by the price ratio of the recovered metal and nickel to obtain the nickel equivalents.

entitled "A pioneer deep ocean mining venture" as the basis upon which to assess the systems proposed by participants in the first and second working groups. The third working group evaluated trends in metal prices, taking into account increasing demand for nickel and the other metals in nodules by China, India and the Russian Federation, and decided to use a range of prices rather than attempt a single projection.[4] The range of cost estimates from the first and second working groups and the Massachusetts Institute of Technology model were incorporated into the International Seabed Authority model along with metal prices representing the lower and upper values in recent years. The range of mining operations, from 1.2 to 3 million short tons per year for a 20-year mine life was also incorporated into the model. Internal rates of return for 12 alternative scenarios produced outcomes ranging from a low of 14.9 per cent to a high of 37.8 per cent.

22. The cost model will need to be reviewed in the light of new developments and fine-tuned for the purpose of the future exploitation code.

23. The exploitation code will require environmental monitoring programmes to be established. It is anticipated that the data and information provided by the exploration contractors will feed into the subsequent environmental monitoring programme and regulations for the protection of the marine environment during exploitation. The regulations will have to be developed following testing of technology. The requirements of the regulations for exploitation will be formulated by workshops and expert groups and made available to the Legal and Technical Commission for its consideration.

24. Exploration contractors are required to, inter alia, conduct environmental impact assessments and institute environmental monitoring programmes during and after (a) dredging to collect nodules for on-land studies for mining and/or processing; (b) the use of special equipment to study the reaction of the sediment to disturbances made by collecting devices or running gears; and (c) the testing of collection systems and equipment. Depending on the specific activity to be carried out, contractors are required to provide information on:

(a) Nodule collection techniques (for example, passive or active mechanical dredge, hydraulic suction or water jets);

(b) Depth of penetration into the seabed;

(c) Running gear that contacts the seabed (for example, skis, wheels, caterpillars, Archimedes screws, bearing plates or water cushion);

(d) Methods for separation on the seafloor of the nodules and the sediment, including, for example, washing of the nodules, volume of the discharge of sediment mixed with water, concentration of particles in the discharged mixture and height of discharge above the seafloor;

(e) Nodule crushing methods;

(f) Methods for transporting the nodules to the surface;

(g) Separation of the nodules from the fines and the sediment on the surface vessel;

[4] The lower limit of the range was determined by indexing the metal prices from the Massachusetts Institute of Technology report using the consumer price index, and the upper limit by using 2007 metal prices, which are regarded as the peak price.

(h) Methods for dealing with the abraded nodule fines and sediment;

(i) Volume and depth of overflow discharge, concentration of particles in the discharged water and chemical and physical characteristics of the discharge;

(j) Location of the mining test and boundaries of the test area;

(k) Probable duration of the test;

(l) Test plans (for example, collecting pattern and area to be perturbed).

VI. Timing for exploitation code

25. As mentioned above, the first contracts for exploration for polymetallic nodules expire in 2016. At that stage, pursuant to the scheme set out in the Convention and the 1994 Agreement, it is expected that contractors will proceed to exploitation. The Council may consider that it is important, therefore, for a regulatory framework for exploitation to be established prior to 2016. This allows for a time frame of approximately four years for the development of regulations, assuming work begins before the end of 2012. Given that it took the Council almost 10 years to adopt regulations for the exploration for polymetallic sulphides, this may be considered optimistic.

26. A further consideration needs to be taken into account, however. Pursuant to paragraph 15 (a) and (b) of section 1 of the annex to the 1994 Agreement, which relates to article 162 (2) (o) (ii) of the Convention, the Council must adopt such regulations within two years of a formal request being made by any State whose national intends to apply for approval of a plan of work for exploitation. While no such request has yet been made, the Council should take note that the effect of any such request would be to put additional pressure on the Legal and Technical Commission and the Council and on the resources of the secretariat.

27. In the light of these factors, it is suggested that the Council may decide that it is timely to begin to elaborate rules, regulations and procedures for exploitation. While such regulations would be targeted specifically at the commercial exploitation of polymetallic nodules, it is assumed that much of the regulatory framework would be common to other resources, and could be transposed to polymetallic sulphides and cobalt-rich crusts in due course.

VII. Proposed workplan

28. The process for the elaboration by the Authority of rules, regulations and procedures for the conduct of activities in the Area is set out in the Convention and the Agreement. Regulations are formulated by the Legal and Technical Commission then submitted to the Council for adoption. Upon adoption by the Council, regulations come into effect on a provisional basis, pending their approval by the Assembly.

29. The issues involved in the development of exploitation regulations are likely to be highly complex and it will be necessary to provide the Legal and Technical Commission with relevant technical advice and information prior to its consideration of detailed draft regulations. Such advice and information would

include information on fiscal regimes for comparable land-based mining; economic assessments of mineral production, including capitalization, operating costs, depreciation and amortization of mines; anticipated tonnages, grades and recovery efficiencies; and other financial and technical issues. Further work will also need to be carried out on the assessment of the potential environmental impacts of future mining.

30. While the secretariat provides technical advice to the Commission on matters within its competence, it should be noted that only limited resources are available within the existing work programme and budget to advance work on exploitation regulations. In particular, the secretariat currently has no staff positions for minerals economists, commercial lawyers or mining lawyers and it will therefore be necessary to have recourse to consultants and advisory meetings of experts to provide the necessary skills and knowledge for this purpose.

31. In 2012, to advance this work, the secretariat used its available financial resources to hire a consultant to begin work on an initial study to (a) provide advice on the scope of the proposed regulatory framework; (b) review the existing and proposed regulatory regimes for land-based and marine mining for commercial norms and precedents that may be considered; and (c) define and assess the impact of economic issues related to applications. It is further proposed to convene a small expert group before the end of 2012 to peer review and refine the initial study.

32. Based on the outcomes of the study and additional technical work that may be identified by the group of experts, it is proposed to introduce an initial outline of draft regulations to the Legal and Technical Commission in 2013. Based on past experience, it is anticipated that the Commission will require at least two sessions to finalize a set of draft regulations. In particular, owing to the complexity of the issues involved, it is anticipated that the Commission may request further technical, economic and financial information and advice. Funds for this purpose have been requested in the context of the proposed budget for the financial period 2013-2014. Should no or insufficient funds be available, it may be necessary to seek extrabudgetary support for this purpose. It may also be noted that a recommendation has been made for the Commission to be able to meet twice in 2013 and 2014 respectively in the light of its increasing workload and to enable it to make more rapid progress on the regulations.

33. Assuming that the Commission is able to advance its consideration of draft regulations in 2013, the earliest it is anticipated that the Commission would be in a position to finalize a recommendation to the Council would be at the twentieth session, in 2014. The position of the Council at that time would be informed by the content of the Commission's recommendation and the continued pace of development of activities in the Area.

VIII. Recommendation

34. The Council is invited to take note of the considerations set out in the present report and the proposed workplan for the development of an exploitation code. The Council is particularly invited to:

(a) Decide that it is timely to begin to elaborate the rules, regulations and procedures for exploitation in the Area, with an initial focus on the exploitation of polymetallic nodules;

(b) Prioritize the development of such regulations within the work programme of the Authority and provide such policy advice on the development of the regulations as may be necessary, taking into account the provisions of section 8 of the annex to the 1994 Agreement;

(c) Invite the Legal and Technical Commission to commence work on an exploitation code in 2013 as a matter of priority and to report to the Council on its work at the nineteenth session.